ENGINEER, ARCHITECT AND SURVEYOR.

Vol. I.—No. 7. CHICAGO, OCTOBER 15, 1874. SUBSCRIPTION $2.00 PER YEAR. SINGLE COPIES 20 CENTS.

GREASY WATER IN STEAM BOILERS.

This subject was recently discussed before the Society of Engineers in Aix-la-Chapelle (Aachen). Lamberts remarked, in the course of the discussion, that in hundreds of cases the use of greasy water has caused a corrosion of the plates of iron used in constructing the boiler, and that it ceased at once on feeding the boiler with fresh well-water. On that ground the construction of warmers in which the water came into direct contact with the exhaust was inferior to the indirect acting through a metal diaphram. In the first a great part of the oil employed for lubricating the cylinder got into the boiler. Bœcking laid stress on the fact that in innumerable cases no injury could be proven to have been done by the condensation water at least. Buettner was of the opinion that the action of the grease was due to its adhering to the metal, and isolating it from the water, so as to expose it to overheating on the side exposed to the fire, since the chemical action of the fatty acids was too weak to be injurious. If we undertake to saponify the fat with soda, we have the disadvantage that the water foams a great deal, and the steam produced carries a great deal of water with it. Dr. Stahlschmidt declared that from a medical stand-point the various undoubted proofs of the injurious effect of grease are a riddle. In the distillation of parafine, kettles are employed which are in contact with fatty acids from year to year, and yet they last a long time. It is desirable that scientific experiments be made on real steam-boilers to explain this phenomenon. Lamberts remarked that the injurious effect of greasy water was experienced to a greater extent in South Germany, where the water frequently contained magnesia, which substance is contained to a much slighter extent in the waters of the Rhine. The fatty acids form with magnesia a totally insoluble soap. By making the experiment on a small scale a white powder will be seen floating on the water, and, on putting the finger into the water, this powder envelops the finger, and protects it from being wetted. Braun called attention to the fact that the carbonate of magnesia, even when the water is not greasy, has an injurious effect, as experience has proven in the case of the waters of Altenberg, Oberschlesia, which contained much carbonate of magnesia. G. Piedbœu, on the contrary, claimed that without any grease the carbonate of lime and magnesia did no injury. As soon, however, as any grease gets in it, a precipitate is formed, which attaches itself to the sides of the boiler, and prevents the water touching it, thus exposing it to the destructive action of the fire. In such cases the evil is at once overcome by taking the water direct from a well or spring, no matter how much magnesia it contains, provided it is free from fat and oil. In a steamship boiler worked with a surface-condenser, after a week's use, both fire-flues collapsed simultaneously, although there was plenty of water present. New York engineers had attributed the accident to want of circulation in the water, and altered the construction of the boiler to that end; but on the return trip the very same thing happened again. To help this, soda has been employed, thereby preventing injury from the grease, but producing a violent boiling over. Finally, sea-water was principally used for feed, and the boiler, was no longer injured by the deposit of grease, but was destroyed by incrustations.

Silica has a totally different effect from the carbonate of lime and magnesia. This, now and then, produced injury in perfectly pure water, especially in mountain streams, by hastening the oxidation of the iron. Von Gizycki stated that after the introduction of surface-condensers in ships' engines, they were soon compelled to mix with the distilled and greasy water, from time to time, a small quantity of sea water, and that at first sea water alone should be employed until a protecting crust had been formed. A ship's boiler, where this precaution had been neglected, was destroyed after four weeks' use, and was found to be covered with a deposite of oxide of iron. Another means that has been employed with good results is to frequently let out the boiler-water from the surface condenser.—*D. Ind. Zeit. and Am. Art.*

The Massachusetts Institute of Technology received a public land grant of 120,000 acres, which realized $78,769 when sold.

Yale college receives for the support of the Sheffield Scientific school $8,100, the proceeds of 180,000 acres of public land scrip invested in State of Connecticut bonds, at six per cent. Cornell University at Ithaca, New York, received scrip representing 990,000 acres.

SEWERAGE IN NEW HAVEN.

REPORT OF E. S. CHESBROUGH, ENGINEER-IN-CHIEF, DATED DEC. 30, 1872.

On the 4th of March, last year, a preliminary report was made relative to the thorough drainage of New Haven. In that report the following conditions were considered essential to any plan that should be adopted:

1. Undoubted efficiency in the works as far as they may be carried out to meet existing demands.

2. Capability of further extension to meet future demands without rendering useless important portions at first constructed.

3. The least possible expenditure compatible with the foregoing essentials; and,

4. The consequent use, as far as practicable, of existing sewers.

And then the following statement was made: "With these leading principles in view we have carefully examined the whole ground. After making measurements of distances and trial estimates of probable cost, we are entirely satisfied that your city can be thoroughly drained without abandoning any important sewers already built, and without resorting to syphon sewers under the railroads; although these, if necessary, would not be very objectionable, for they have been in successful use for years in Paris and Hamburgh." Since the date of that report much time and labor have been expended in additional surveys, estimates, comparisons of plans and other investigations, but without producing any change as to the conclusions arrived at, except in relation to a very few of the sewers previously laid. All sewers constructed by the city since then have been in accordance with the foregoing recommendations.

In this my final report on your general system of drainage, it may be of interest to many to see stated certain general considerations with regard to city drainage.

The benefits of drainage.—Inasmuch as New Haven is now committed to the construction of a general system of sewerage, it would seem more fitting to wait the short time necessary to show what the result will be than to make statements which many may look upon as simply hopeful prophesies. It is nevertheless a well established fact that wherever a judicious plan of sewerage has been faithfully carried out satisfactory results have been obtained. If apparent exceptions to this rule may be pointed out, they can be traced to known, and with one exception, to avoidable causes. This exception is the proper disposal of sewage; and will be spoken of at some length below.

Perhaps no city in this country presents more natural difficulties in the way of a self-acting system of sewerage than Chicago, and it must be confessed that some very offensive nuisances still remain to be remedied; yet Dr. Rauch, the sanitary superintendent of the city, who was in no wise responsible for the plan of sewerage adopted, speaking in his "Sanitary History of Chicago," page 257, of the Sewerage Act (of the Legislature) of February 14, 1855, says it is "an Act which has done more to promote the public health than all others before or subsequently passed." To-day the greatest contests in the City Council are over the districts to be drained first, the strong public opinion, based upon mortuary statistics, being that sewers are a vital necessity.

All attempts at proving the precise effect of sewerage on the health of a city has been unsuccessful hitherto, and are likely to remain so because of the impossibility of eliminating the various other causes which affect it, such as density of population, quality of water used, habits and occupation of the people, temperature, rain-fall, epidemics, etc., etc., but notwithstanding this uncertainty, enough is positively known to justify the advocates of thorough town drainage.

[Here follow tables prepared by Dr. Rauch: 1, On the rain-fall for the years 1866 to 1872 inclusive; 2, on the mean temperature of the months of June, July, August and September for the same years; 3, mortality of children under six years of age, in wards numbers 3 to 18 inclusive, for the year 1872; 4, infantile mortality in 1872. Table No. 1 shows that the *less* the rain-fall the *less* the mortality. No. 2 shows that as a rule the *higher* the temperature during the four months tabulated, the *less* the mortality. No. 3 shows conclusively that the *greater* the number of lineal feet of sewers to each inhabitant the *less* the mortality, and that the greatest number of children die in the last three months of the year, and the least in the four months of June to September inclusive. No. 4 shows that the *total* infantile mortality was greatest in the month of August. This was true also of those under five years, of age while the month of September was fatal to the greatest number of those over five years.—ED.]

Dr. Rauch also says: "Prepare tables and group data as I may, the same general facts meet me. This is the more noticeable when it is borne in mind that we know positively how many feet of sewers have been constructed, and how many deaths occur in each ward, but we do not know with any certainty what the population was in each year, as it was in some years only estimated. With these uncertainties, and making due allowance for all errors, the result is the same.

"At no time since the construction of sewers commenced in this city have they been adequate to the sanitary requirements, and as long as this state of things continues, owing to the topography and character of the soil upon which the city is built, we must expect to have a high death-rate, particularly among children. The general death-rate is not as high as in some other cities; but as I have before shown, the infantile death-rate is higher than in any other city in the United States."

Requisites of good drainage.—To drain a city perfectly the sewers should be of such size, form, inclination, workmanship, and depth below the surface as to convey, without deposit or stoppage, to the main outlet and by means of the ordinary quantity of water used for domestic and other purposes, all the substances that are usually discharged into them from private houses, street surfaces, and when not injurious to the health of the men who have occasionally to enter, examine, cleanse or repair them, all the liquid refuse from manufacturing and other establishments. These requisites are not always attainable at a reasonable expense, and hence compromises are often resorted to, especially when it is deemed impracticable to raise the funds necessary to carry out a perfect system. For this reason sewers are often laid too shallow to drain thoroughly the soil beneath the foundations of buildings, and with inclinations too slight to prevent deposits from forming in them.

Main outlets and disposal of sewage.—The getting rid of sewage after having successfully removed it from private houses and other buildings of a city often causes more perplexity than all the rest of the system of drainage.

If discharged into any stream or body of water too small or shallow or sluggish to deodorize and neutralize it with sufficient rapidity, it will sooner or later become a nuisance that must be abated at whatever cost.

To avoid or remedy this nuisance vast sums have already been expended in the construction of intercepting sewers, pumping, irrigating and deodorizing and other works in Great Britain and on the continent of Europe;

and the cities of this country are already seriously considing the subject. The whole question, however, of the proper disposal of the substances now allowed to enter sewers is far from having received a satisfactory solution applicable to all cases. In particular instances, under peliar local and favoring circumstances, irrigating works have proved so successful and profitable as to lead many to suppose that such would be the ultimate and general method of disposing of sewage; but, as yet no city containing 100,000 inhabitants is known to have been able to apply it successfully to all the discharge from its sewers.

The advocates of the *dry earth system* have thought their method offered the only practical solution of this question; but however satisfactory and profitable "earth closets" may have been in particular instances, the system has utterly failed to establish itself generally in any important town, not only because modern taste revolts at the idea of giving up the neat and luxurious water closet, but because the dry earth system cannot, by any practicable means, be made to take care of most of the other substances besides human excreta that ordinarily enter sewers.

Deodorizing Works, by which is meant places and arrangements for mixing lime or cheap chemicals with sewage, though still resorted to in some cases, are now almost universally regarded as unsatisfactory and inadequate. They are very expensive and all attempts hitherto to manufacture solid manure from the deposit thrown down by them have proved commercial failures whenever attempted on a large scale, in consequence of the escape or neutralization of the most valuable fertilizing constituents of the sewage. With all the light at present possessed on this subject, there appears to be no other feasible method of disposing of the sewage of cities, especially in the northern and colder portions of our country, than that of conveying it to some comparatively rapid stream or body of water agitated by winds and waves, and sufficiently extensive to neutralize it. In this connection a practical question of great importance often arises with regard to what is sufficient to neutralize sewage or render it innocuous. It will be evident, upon the least reflection, that several elements must be considered. The population of the two cities may be equal, but the habits and industries of the two and, consequently, the quantity of sewage from them may be very unequal.

If the quantity should be the same, the character may be very different in some respects. Fresh and salt water are very different in their capacities for neutralizing sewage, the former being decidedly superior in this restspect.

While small towns and cities often experience little or no inconvenience in disposing of their sewage at first, they become more and more embarrassed with it as they increase in size. The most that has been done hitherto in this direction, has been partial and experimental; but the experience of the past is of great value in the planning of new works.

The results of the grand systems of intercepting sewers carried out in London and Paris, show clearly that it is possible to relieve, to a great extent, the inhabitants of large cities of the evils of discharging their sewage into receptacles from which it is sent back to them through the air. And yet the outlets of those intercepting sewers are complained of, showing that the nuisance, while removed from the many, is imposed upon a few. For this reason various schemes have been proposed and some experiments made to remedy the evil altogether, but thus far only a small portion of the sewage of either city has been disposed of except by discharging it low down into the Thames or the Seine.

While the attention of many of the best minds in the world is still occupied with this unsolved problem, that is in its universal or general application, the necessities of cities and large towns are often such that they must do something to mitigate the evils of insufficient or defective drainage. In such cases they have to do what men usually do in other emergencies, the best they can. A decided improvement upon an old order of things is not only of great value frequently but sometimes of vital importance. Perfection in this matter, to any great extent, has not been attained yet and may not be for a long time to come.

The most inviting field of improvement in this connection is offered by the enormous value of the fertilizing substances now wasted in city sewage. Hitherto all attempts to utilize them have proved either totally insufficient in extent or unprofitable in their results, except in some peculiarly favorable locations where irrigation with sewage has proved both successful and profitable.

The requisites for success in this direction are a sufficiently mild climate in which grass at least will grow nearly all the year, and the existence, within a reasonable distance, of a large body of porous soil, the cheaper the better, not likely to be needed for many years for other than agricultural purposes; as the large amount to be expended for the necessary pumping engines, pipes and other accessories for sewage irrigating works would, in a great measure, be lost if the lands irrigated should have to be given up for building or manufacturing purposes. And yet there come to us uncomfortable rumors that in some cases the sanitary condition of the districts in which lands thus irrigated are situated, has been injured by the system, though this is generally denied or said to proceed from defective arrangement.

In view of the foregoing considerations, the general plan recommended in the preliminary report for the drainage of New Haven, since elaborated and carried out, will now be described.

The area of the present corporation limits of New Haven, between Mill and West rivers, is about thirty-eight hundred acres. A small portion of this area, about two hundred acres bordering West river, and about one hundred acres bordering Mill river, is salt marsh.

The topography of the City is such as to afford facilities for the construction of an excellent system of drainage at a very reasonable expense. The locations of the railroads, particularly the Derby Road and the Northampton Road, render necessary a modification of what would otherwise be the most natural and efficient plan.

The surface drainage of the eastern part of the City, comprising an area of about eighteen hundred acres, flows into Mill river. That of the central district, about twelve hundred acres, flows southerly into the Harbor. The western district,an area of about sixteen hundred acres,is drained by the West river.

The elevation of the central portion of the City, is about twenty feet above tide. The elevation of College street directly in front of the principal College building is about forty feet above tide. This plain rises very gradually in a northerly direction. The elevation of the summit between the Harbor and West river is about forty-five feet above the tide at the intersection of Orchard street and Whaley avenue.

Prospect Hill in the eastern district rises to about one hundred and fifty feet above tide water. (Here follows a description of the localities of the 5 proposed Drainage Districts.—ED.)

With reference as to the kinds of material of which the sewers are to be built, it is recommended that all sewers of two feet interior diameter and above be built of brick; below 18 inches in diameter, they should, in my opinion, be made of vitrified stone ware pipes. Either vitrified pipes or brick may be used for sewers between 15 inches and 24 inches in diameter, as may seem most judicious—depending upon prices of material and nature of ground.

The cement pipe sewers hitherto adopted and used in New Haven appear to me to be very good of their kind, and may never cause serious trouble; but the experience and observation of twenty years, together with the conviction of eminent engineers, who have given much attention to the subject, satisfy me that with equal care and skill it is decidedly safer to use hard burnt clay than cement pipes. Whatever material may be adopted, skill and faithfulness in carrying out the work will be absolutely essential to secure good results.

The extensive correspondence of the City Surveyor with Engineers and others in the most important cities of our country on this subject is very interesting and important, and confirmatory, on the whole, of the views above expressed.

House drains should in all cases connect with the sewers at angles considerably inclined down stream, in this respect resembling the union of small veins with large ones in the human system. Private drains should be six inches diameter for each ordinary house and larger for manufacturing establishments. The practice of cutting into pipe or even brick sewer to make junctions with house drains, etc., is very pernicious, especially when not done under the immediate inspection of a competent mechanic. This is a matter of sufficient importance to demand special attention, because much of the trouble experienced from the deposit of sediment in the sewers can be traced directly to the careless and unfaithful manner in which these connections are frequently made.

With regard to the form of sewers, the egg-shape (see "Examples of Sewers" Fig. 10 in No. 4 of the ENGINEER ARCHITECT AND SURVEYOR,) is recommended for those above fifteen inches up to the size of the equivalent of a circle forty-two inches interior diameter; over that size they should be circular. When the cutting is not deep and it is advisable to raise the grade of the street, the circle should be used for the small manufactured sizes to save the height of the sewer.

Sewers should be laid, if practicable, some months before the streets are paved, and the house connections carried to the curb line at the same time. * * * * *

There are extensive districts yet to be laid out, and these should be carefully studied in reference to sewerage, the general plan of which would be accomodated by any proper mode of laying out new streets.

The following general rules have governed the determination of the sizes and the inclination of the sewers.

The least inclination or grade of a twelve inch sewer to be one in three hundred or four inches in one hundred feet.

The least inclination of an eighteen inch pipe sewer to be three inches in one hundred feet.

No connection to have an angle exceeding forty-five degrees. As a general rule the junctions are to be made at an angle of thirty-six degrees and the curve on a radius of twenty feet.

At all junctions the affluent sewer should have an increased inclination to allow for the curve.

The axis of the main sewer, and that of the lateral, at the point of junction, should, when practicable, be in the same horizontal plane.

Where the axis of the lateral sewer is placed much below that of the main sewer, deposit of sediment is liable to be formed in the lateral.

(TO BE CONTINUED.)

A discovery of interest to wood engravers is the fact that plates of polished slate may be used as substitutes for box-wood for engraving. These plates will furnish over 100,000 impressions without loss of detail, do not warp, and are not affected by oil or water.

COAST AND HARBOR SURVEYING.

A LECTURE BY R. M. BACHE, ASSISTANT U. S. COAST SURVEYOR, DELIVERED IN NEW HAVEN, CONN., MARCH 26, 1873.

Surveying, although in a certain sense simple, is in practice extremely difficult, requiring the highest kind of skilled labor. It is not a little dependent upon manual dexterity and general functional ability, which, practice apart, are a subtle product of individual organization. These are as necessary as the most perfect comprehension of methods. A surveyor, if a good one, is an excellent compound of exercised natural qualities; and as the first of instruments in surveying, I put him first.

In thus speaking, I refer merely to the skilled workman, the day-laborer, as it were, of geodesy. When the higher branches of the science are reached, problems are afforded taxing the resources of the ablest mathematicians and astronomers.

The positions of any two objects on the earth, are, without considering scale, representable by placing upon a plane surface—say paper, to become a map—the signs for them, at any distance, great or small, from each other, at which they shall appear apart. By including a third object, we introduce *relative* distance, therefore proportion; and if, by means of measurement, whether on the earth or map, we know only a single one of the distances, we can, by means of angles, find out the two others also, and obtain a definite circumscribed area. And a basis has thereby been secured, beyond which we need not proceed, except by repetition of the same process, in order to lay down the positions of all other objects upon the same surface. Thus, all objects upon the earth's surface, and, indeed, everywhere in the universe, are in fact, at a given moment of time, bearing to each other relations representable by threes, forming triangles, and these relations involve all the apparently more complex ones. It is obvious, therefore, that if we have the means of determining the dimensions of these triangles, we have the means of establishing all possible relations in position among objects upon the surface of the earth; and we have the means. This is the fundamental perception upon which is based the practice of triangulation, whether it cover a great or a small area; the fundamental practice of geodetic surveying, whether in triangulation, topography, or hydrography.

It is conceivable that, if we have the dimensions of a single triangle on the globe, and no great body of water inferior with our operations, we might, from one of its sides as a base, extend an ever-spreading series of triangles around the globe, and join with perfect accuracy the other sides. This was formerly the theory, in practice it was found not to be true; for, independent of the fact that the calculations would proceed upon the supposition that the figure and unequal density of the earth are known exactly (and although we possess an approximation to the truth, we do not possess the truth exactly), instruments are not perfect, observers have their idiosyncracies, and atmosphere and temperature play their part in vitiating results. How these difficulties are obviated will appear as we proceed.

In applying the method of triangulation to the kind called primary—that is, triangulation of the highest order, the one in which the triangles are the largest and most carefully measured of any—the first procedure consists in the measurement of a line of considerable length, called the base.

The base forms the first line of the first triangle. The apparatus used on the Coast Survey, for the measurement, is of exquisite workmanship, and of such exquisite nicety in its performance, that the probable error in measuring a mile with it amounts to only 1-200th of an inch.

Not many places on the earth's surface affording ground for the direct measurement of lines, and the facility of elevations beyond, upon which to carry forward with advantage a triangulation, the first triangle (which is nearly equilateral) is, from necessity, relatively quite small. But by a gradual increase in the size of the triangles as they proceed from each other. their sides become longer and longer, affording longer and longer base for further triangles, some of the lines measuring over a hundred miles.

Wherever feasible, the triangles are arranged in quadrilaterals, both diagonals of which are observed. Thus, you see by this diagram, three stations giving one triangle only, but, with the addition of one station, giving four triangles; the diagonals of the quadrilateral bracing the whole work together.

Were it not for the extreme nicety of the instruments and processes, and for the care bestowed upon the measurement of the base and primary triangles, error would soon become very considerable. But owing to the circumstance of that extreme nicety and care, to the inclusion of independent determinations, to the tendency of error to compensate, such is not the fact. In practice, error is, as far as results are concerned, eliminated. By repetition of observations, taking means, checking by bases of verification, by additional geographical positions, determined astronomically, it is so divided, subdivided, and diffused, that, rendered imperceptible, it may, humanly speaking, be said not to exist.

At every turn vigilance is exercised, no faith is put in the testimony of the individual observation. Instruments are cross-questioned, and by repeating are made to witness against themselves, and then the mean is taken of all their testimony. We make them speak the truth as nearly as they are capable, for the *exact* truth is not in them. The peculiarities of the observer himself are ruled out by what are called "personal equations." And, finally, the higher mathematics steps in with its theory of least squares, the theory of probabilities, and adopts, reconciles, and rejects, winnowing for the truth, putting it to the test of figures, which embraces the whole evidence and cannot lie.

It would be altogether useless to continue from first to last the highest refinements in the operation of surveying, and, in consequence, primary triangulation affords the only example in which operations proceed from an interior to an exterior. In the interest of economy in time and labor, combined with sufficient accuracy for all practical purposes, the system of working from an exterior to an interior, which admits of work of less precision, is employed for all the other and lesser operations of geodetic surveying. Thus, descending from primary triangulation, we have secondary and tertiary, each series being composed of a set of smaller triangles than the preceding.

It remains that any series of triangles can be placed in position with reference to the whole earth, and this is accomplished at an astronomical station, by observing for the true meridian, and then finding what bearing with it one of the triangulation lines has. Supposing that the earth were of known and uniform density and figure, and that no errors, instrumental or other, entered into the triangulation, the laying down of one line with reference to its bearing to the true meridian would be sufficient to put a whole triangulation in position. These things not being so, this bearing, which is called the azimuth, must frequently be observed throughout a triangulation.

How accurate triangulation is, may be brought to your minds by mention of the result of the test afforded by a base of verification—that is, by the direct measurement on the ground of a side of one of the triangles, which measurement should, of course, agree with the length of the same line as derived and computed from the triangulation. The measure of a base of verification, in France, differed less than a foot from the measure of the same line as found by computation through a chain of triangles of four hundred miles long. The measure of a base of verification, on Salisbury Plain, England, differed less than an inch from the measure of the same line as computed from a triangulation of a hundred miles in length. The Coast Survey affords the example of a base of verification differing by only four inches from the computed length, although, to reach it, the triangulation passed over more than three hundred miles.

The latitude of a place is, equal to the altitude of the visible pole at that place; also, the difference of latitude of two places is equal to the difference at the two places of the altitude of the visible pole. Suppose, now, two or more places on the earth's surface of known difference of latitude, to be connected by a triangulation. The base of the triangulation has afforded units of length; the triangulation has applied them even to the extreme distances; repeated azimuths have kept the whole network in position; and the heights of one or more of stations above the level of the sea have given the data for reducing the whole work to that level. Knowing, therefore, for the portion of the earth's surface covered by the triangulation, the distance corresponding to the difference of latitude of the places, we know, also, by comparison with other measurements in different parts of the earth, where and how much, within certain limits, the earth departs from uniformity of figure, both general and special, that is, the amount of its ellipticity, and of local irregularity in the area triangulated.

We know, besides, in that triangulation, the geographical position of every point observed upon. We can reduce that triangulation to a plane, or we can reduce it to the curved surface which it actually covers—the surface represented by the level of the sea. So, also, we can combine the difference of *longitude* between points with triangulation between them. We can, to obtain the exact figure of the earth over large surfaces, combine measurements of meridian and measurements of parallel, each with the same kind, and either with the other. By these operations we have compared measurements on the globe with corresponding celestial arcs and angles; have fettered in indissoluble bonds the most remote not less than the least remote objects; and these operations in sum form the highest order of geodetic surveying.

The determination of longitude is made in many ways. The one most satisfactory, in general use wherever practicable, and distinctively American in its origin, is by telegraph. The present methods are by exchanges of either star or clock signals.

In exchanging star signals an observer at one station notes the passage of a star over the meridian, by touching a key which records the clock time of the transit both at his own station and that of an observer further to the west, who, in turn, when the same star passes his meridian, similarly records the transit, both at his own station and that of his colleague. The method is specially adapted to stations differing not more than half an hour in longitude. A little reflection will show you that, independent of the fact that weather favorable for the observation of consecutive transits is less likely to occur, the remoter the stations from each other, the business of the country cannot be checked by use of the telegraph wires for hours and hours together. Hence, when the difference of longitude much exceeds half an hour, as in the case of the late trans-continental determinations, the method of exchange by clock signals is found more convenient.

In this method the several stations being in telegraphic connection, the eastern clock is thrown into the main telegraphic circuit, so that its beats are recorded at its own station, while at the same time the clocks at each of the western stations are made to record their own beats upon their

local circuits; and thus comparisons are obtained at each western station between the clock there and the eastern clock.

After being in the main circuit about five minutes, the eastern clock is taken off, and the clock at the next station west is put into the main circuit, and so on, until at each successive station a comparison has been recorded between its clock and the clocks of all the other stations.

I should mention that there are other methods of determining the ellipticity of the earth, besides those of geodesy: namely, the length requisite for the seconds' pendulum, varying in accordance with the variance of centrifugal force owing to the elliptical form of the earth, for every change of latitude; and most wonderful of all, the determination of the amount of ellipticity by lunar perturbation, caused by the action of the protuberant matter of the equator upon the moon's motion in its orbit. The usual method adopted, however, from which are derived the general dimensions and figure of the earth, is by means of the gradual determination of points on its surface, that is, by geodesy.

[*To be continued.*]

HENDERSON (KY.) WATER-WORKS.

BY G. M. ALVES, RESIDENT ENGINEER.

As a subject of interest to many of your readers, I send you the following concerning our proposed water-works. There are five divisions; being respectively, Engine Pit and laying Suction Pipe, Reservoir, Pipes and Special Castings, Laying Pipes, and Pumping Machinery. The bids on the several divisions were opened on the 15th of August, and are as given below. It appeared from a canvass of the bids that J. G. Eigeman & Co., of Rockport, Ind., at $9,335.70 were the lowest on division No. 1; John Haffey of this place, at $12,694.00, was lowest on division No. 2; R. D. Wood & Co., of Philadelphia, at $29,131.50 were lowest on division No. 3; and John Haffey, of this place, at $5,190.00, was lowest on division No. 4. Besides these divisions there are other items, such as stand-pipe, fire-plugs, valves, &c., contract for stand-pipe being gotten by G. W. Hider & Co, of Louisville, at $1,575.00.

The following are the bids on the several divisions:

Division No. 1, consisting of 1030 cubic yards of stone-masonry (70 yards of concrete included in same), and laying abont 300 feet of 12-inch suction pipe; prices were per cubic yard for masonry, and per lineal foot for laying suction pipe.

There were seventeen tenders sent in on this division. The highest was that of Cox & Walker, $32,100, their prices being $30.00 for the masonry and concrete, and $4 for the pipe laying; and the lowest was that of J. G. Eigeman & Co., $9,335.70, their prices being $8.19 and $3 respectively. The average prices of all the tenders were $13.78 for the masonry and concrete, and $3.33 for the pipe laying; the highest in each case being $30 and $10 respectively; and the lowest $8.19 and 50 cents. The tender nearest to the average price was that of J. W. Rutherford & Co., at $13.50 for the masonry and concrete, and that of J. Haffey at $3.25 for the pipe laying; these two prices combined give a total amount of $14,880, while the average prices of $13.78 and $3.33 give an amount of $15,192.40. It will thus be seen that the highest tender was more than twice the average, and almost three and one-half times the amount of the lowest tender; a remarkably large difference.

Division No. 2., consisting of 10,000 yards excavation A, 4,000 yards borrowed earth, B, 3,000 yards puddle C, 80 yards stonework D, 280 yards concrete E, 680 yards brick masonry F, and 1,200 yards soiling G; the prices are shown by the following table, all the prices being in *cents:*

	Highest.	Lowest.	Average.	Nearest price to average.	Successful tender.
A	49	19	32	31	20
B	57	23	35¼	35	23
C	265	50	136	135	65
D	1500	700	1081¼	1000	980
E	850	367	580	600	625
F	1075	650	765	790	725
G	60	13	37	35	20

Division No. 3, consisting of 390 tons of 12-inch pipe A, 180 tons of 6-inch pipe B, 20 tons of 4-inch pipe C, and 12 tons of special castings D. In this division the highest, lowest, average and nearest to the average of the bids were, for A—62.50, 47.85, 53.03, 52.00; B—68.00,47.85, 53.81, 52.00; C—same as B; D—84.75, 48.40, 71.88, 70.00, all prices being in dollars. The prices of the successful tender were, A, B, and C, $47.85; D, $75.00. In this division it is to be noticed that there is very little difference in the prices tendered, between A, B and C, showing that the different sizes of the pipes, 12, 6 and 4, inches had very little effect upon their estimated cost; it is only in D that much difference is noticeable between the highest, lowest and average prices for the special castings.

Division 4, consisting of laying 8,000 feet of 12-inch pipe A, 10,000 feet of 6-inch pipe B, and 1,550 feet of 4-inch pipe C. In this Division the highest, lowest, average and nearest to the average of the tenders were, for A—70, 30, 48⅔, 49; B—60, 24, 34⅔, 33½; C—50,20, 28½, 29; these prices being in *cents*. The prices of the successful tender were, A—31, B—24, and C—20 cents.

(TO BE CONTINUED.)

SEWER PIPES: CEMENT v. STONEWARE.

We reprint below an interesting series of letters from various city engineers, the result of a correspondence which took place in August and September, 1872, between them and the City Engineer of St. Louis, Mo. J. B. Moulton, Esq., C.E., who had recommended the exclusive adoption of stoneware sewers for that city:

I have never used the cement pipe for the purpose of sewerage, and have no personal knowledge of its value in that connection.

While I had charge of the sewerage works of Cincinnati none but the vitrified pipe was used, nor has any other been used in that city so far as I know. Only vitrified pipe is used in Washington at present, and I am not certain that cement has ever been used there.

I regard the Scotch pipe as the best for the purpose, and the American when well made as almost equal to it. I am of the opinion that cement pipe might be made to answer well, but it is open to the objections of porousness. As a rule it has less strength, and is liable to great variation in quality, growing out of the difference in material and the proportions used, and finally, from the manner of making. As to the action of the acids and alkalies upon it I should not regard as a serious objection, since my observation upon the mortars used in brick sewers satisfies me that there is little danger from this cause. I should prefer the vitrified pipe by all means.

R. C. PHILLIPS,
Chief Engineer Board of Public Works, Washington, D. C.

In conformity with your request of the 20th, I send you the accompanying copy of a report I made on the 16th of July to our board on the subject of sewers.

Since then I have received a letter from the City Engineer of Cleveland, Ohio, who speaks very decidedly in favor of cement sewers, after an experience of three years with them in that city. I have also conversed with Mr. Wesson, who had charge of the sewerage department of the Croton Aqueduct Board for a number of years, and he speaks very decidedly against them. He told me that he dug down to quite a number in Jersey City and found every one more or less disintegrated on the outside.

E. S. CHESBROUGH, City Engineer of Chicago.

Board of Public Works:

GENTLEMEN—The secretary's letter of the 13th, informing me that you desire a report from me of "the value," in my opinion, "of cement pipes for sewerage purposes," has been received. I take it for granted that the board meant cement pipes as compared with hard-burnt or vitrified clay, as no other kinds are used to any considerable extent in this country, though wood, asphalt, and iron are in particular localities used for special reasons.

I have given personal attention to this subject for about twenty years, and have both conversed and corresponded with other engineers relative to it.

Cement pipe sewers have their advocates, and are used to a considerable extent in Brooklyn, Buffalo, Jersey City and New Haven, and other cities. Some have been laid twenty years, and are in good condition yet. Others have failed in less than three years. Similar failures occurred with hard-burnt pipes in England, where, for years after their introduction, there was strong opposition to them, until their manufacture was brought to comparative perfection. Now the use of those pipes in that country is very general, especially for house drains.

Either kind of pipe requires skill and faithfulness on the part of those in charge of the laying of the sewers. The ease, however, of judging of the suitableness of a burnt pipe for a sewer is much greater than in the case of a cement pipe; in fact, it is very difficult, if not impossible, to be certain with regard to the cement pipe, while it is not so with regard to hard-burnt clay.

Cement pipes have been slowly disintegrated by certain gases and acids emptied into them. Some very striking instances of this kind occurred in San Francisco, where urine from privies was discharged into the cement pipes. Nothing of this kind has ever occurred, so far as I can learn, with well burnt pipes.

My opinion is that hard-burnt or vitrified clay pipe should be preferred for sewerage purposes to cement pipe, because of the much greater certainty of getting a good article of the former than of the latter; and in this respect I have the concurrence of several distinguished members of my profession, who have come to their conclusions on the subject after years of observation and experience.

E. S. CHESBROUGH, City Engineer.

Our commissioners of sewers as well as myself, are not in favor of using cement pipe for sewerage purposes, confining ourselves entirely to the use of glazed stoneware or vitrified pipe. We do not think the cement pipe, for durability and its capacity to resist the action of acids and other deleterious substances which are committed to public sewers, has been sufficiently tested by time. And we have high authority for believing pipe made of burnt clay, glazed and vitrified, will last for centuries. In matters of this kind we do not care to experiment. A. W. GILBERT,

Engineer to the Sewer Commissioners, Cincinnati, O.

The cement drain pipe, as made here, is good; they are carefully made, and are more uniform and in better shape than the stoneware, and average about 15 per cent cheaper. We are using them in almost all cases, until recently, however, the stoneware was preferred, but as a great many of them were shattered by burning, and the supply became short, a trial was made of cement, which gave perfect satisfaction. I am of the opinion that the cement drain will answer every purpose.

THOS. P. SHANKS, City Engineer.

The duty of prescribing or even recommending the style of material for drain pipes in this city does not devolve upon me but upon an officer styled the "Superintendent of Sewers," who is a professional civil engineer, and has made drainage engineering a specialty. I have frequent intercourse with him, and our views generally coincide on matters relative to his department. He informs me that he has laid several thousand feet of it and has had no trouble from sewer acids, but that it frequently breaks or cracks longitudinally when laid in clay or heavy soils, but in sandy soils, where care is taken to pack the sand well around the pipe, it stands very well. He also says that he has frequently to reject a portion of the pipe when delivered on the ground on account of imperfections. The cement pipe in use in this vicinity is made from the best of Newark new cement and sea-washed gravel, screened to a size considerably coarser than the coarsest of bank sand, and in some cases Portland cement is used. The article manufactured here by Messrs. Day & Collins is as good a cement as I have ever seen, but the best I have no hesitation in saying is inferior to good vitrified clay pipe.

If I had charge of the sewerage works of this or any other city, I should recommend the use of the vitrified clay pipes in preference to cement, notwithstanding the difference in cost. I regard cement pipe as worthless unless made of the best of materials, and even then it is not as good as the other. N. HENRY CRAFTS, City Engineer, Boston, Mass.

In the first place, the only stoneware pipe which is approved here is the imported "Scotch" pipe. It is truer in shape—a most important feature—more uniformly burnt, less brittle, and with a better glaze. All these merits, with the additional cost of transportation and consequent loss by breakage, makes them more expensive than the American pipe, and it is with this expense that we compare the cement pipe. The latter, when well made, as Knight's pipe is, and well seasoned, say eight or nine months, is, so far as we can judge, equally good with the "Scotch" pipe. You know we are beginning to import Portland cement, as two or three times the strength of our best cements. A small addition of this adds great strength to the cement pipe. The economy in first cost of the best cement pipe is still so much cheaper than the "Scotch" as to render it popular with the tax-payers, even if an occasional failure was the result. The possible difference in your clay, and the additional cost and inferiority of your cements, may render your stoneware pipes even better than your cement pipe. I am free to confess that in my opinion the value of the pipe is very largely due to the careful and faithful method of making and seasoning pursued by Knight in his manufacture, and I would be very cautious about using much pipe merely because it was made of cement.

J. W. ADAMS, City Engineer, Brooklyn, N. Y.

(Statement inclosed in foregoing.)

SIR; In reply to your note of this date I would beg leave to say that we have laid the cement pipe of Knight to a large extent in this city. I I would remark that the method of manufacturing the pipe has much to do with the durability. *Any* pipe of cement and gravel will not answer, but with good cement and clean gravel, well rammed, we have found the pipe to answer every purpose of a drain pipe, and no case, to my knowledge, has transpired where it has given out from the action of any acids in the sewerage. The "Scotch" pipe is equal to it in durability, but costs from 25 to 40 per cent. more, and the difference in cost renders the cement pipe the cheaper, even with the defects which have appeared in some cases, attributable to the want of seasoning in the pipe after it was made, and before laying. This is important to look to. It is better than the American stoneware pipe, and when made with the precautions I have named is sufficiently reliable. J. W. ADAMS, Chief Engineer.

On receipt of your letter of August 26th, I referred it to Mr. Rathbun, whose answer I enclose and fully endorse. All the pipe laid here has been done under my personal supervision. I have never heard of any failure in any sewer where it has been used.

The value of the pipe depends entirely on the quality of the cement and the sand, and the materials used here are perfectly satisfactory.

Mr. R. thinks that yours is made from Louisville cement, an article that he would not use.

The Rosendale cement is brought from near New York city, although a good quality of cement is made within twenty miles of Mr. R.'s works.

Yours, respectfully, JOHN M. DITTA, Engineer.

(Letter enclosed in foregoing.)

I should say that cement pipes have been in use, both for public and private sewers, in this city, for seven years, and that no failures are reported; that large quantities are being continually used, and further that the parties engaged in their manufacture in this city use only the very best of Rosendale cement and clean, sharp lake gravel, and manufacture a pipe that has been universally adopted, &c., &c. C. H. RATHBUN.

(From the card enclosed with this letter it appears that Mr. Rathbun is a cement pipe manufacturer.)

(TO BE CONTINUED.)

IT is now claimed that New Mexico contains a population of 90,000, and from present indications it is probable that it will be soon admitted into the Union as a State. On this subject the *Kansas City News* remarks that it "was one of the results of the Mexican war, and came into our possession in 1849. In 1850 it became a territory, with an estimated area of 215,807 square miles, which was soon afterward increased to 261,340 square miles. In 1861, 14,000 square miles was set off as the territory of Colorado, and soon after another portion, 126,141 square miles, were set off as the territory of Arizona, leaving an area of 121,210 square miles as the territory of New Mexico.

ENGINEER, ARCHITECT AND SURVEYOR.

A MONTHLY JOURNAL OF PRACTICAL ENGINEERING, ARCHITECTURE SURVEYING, MECHANICS, HYDRAULICS, MINERALOGY, METALLURGY, AND KINDRED SCIENCES.

PUBLISHERS' ANNOUNCEMENTS.

Terms of Subscription:

TWO DOLLARS PER YEAR..... Payable in advance.

TWENTY CENTS FOR SINGLE COPIES.

English and Canadian subscribers can be supplied with the paper by Post Office Order for two dolllars and fifty cents present currency, (including postage), made payable to the Editors of "THE ENGINEER, ARCHITECT, AND SURVEYOR," Chicago Ills.

Rates of Advertising:

1 inch, vertical, single column, six months	$10.00
1 " " " one year	15.00
1 " " double column, six months	20.00
1 " " " one year	35.00
1 " single insertion, single column	2.00

Binders for holding the loose numbers of this Journal can now be had at the office for the following prices:

Half bound with cloth,.....70 cents.
Whole cloth,.....80 cents.
Half bound with leather,.....One Dollar.

Our subscribers should realize the importance of having binders to hold the loose numbers of their Journals. THE ENGINEER, ARCHITECT, AND SURVEYOR, will always be valuable as a book of reference, and as our back numbers are rapidly becoming exhausted, we shall very soon be unable to replace any copies which our subscribers may have lost, or which may have been soiled or defaced through being scattered about carelessly.

Illustrated Supplements.

A few copies of the following lithographic Illustrations may still be had, postage paid, on the receipt of 10 cents at our office, or with the accompanying regular number of the Journal, for the sum of 20 cents each copy:

Examples of Sewers, and Faults in Building them,...Suppl't to No. 4.
New Harbor Works at Chicago, Ills.,..... " " 6.

In a few days an Illustrated Supplement will be issued, descriptive of the mechanical exhibits in the Illinois Inter-State Exposition, in this City, which was closed on the 10th inst. This Supplement will be issued FREE to our regular subscribers, and paged to be bound up with the file of the Journal.

We beg to remind our subscribers that by the new Postal act passed by Congress last July, on and after January 1st, 1875, all publishers will be obliged to prepay the postage on the journals, magazines, and newspapers, &c., which they publish. In consequence of these new regulations, we shall be charged by the Posmaster 1 cent per month per copy for all copies sent to subscribers on and after January 1st next.

We therefore request each of our subscribers whose subscription terminates with the last number of Vol. 1, to send us 3 cents apiece as postage on their journals for the months of January, February and March, 1875; and from those subscribers whose subscriptions extend further into the year than the end of the first volume, we request as many *cents* as their paper extends *months* into 1875.

Articles intended for publication should be sent in by the tenth day of the month. Contributions solicited. All communications relating to THE ENGINEER, ARCHITECT, AND SURVEYOR should be addressed to

THE EDITORS, 168 Washington Street.

TO THE PROFESSION.

The ENGINEER, ARCHITECT, AND SURVEYOR is pre-eminently the organ of the above named professions in the United States. *It is their paper.* It does not conflict with any other scientific or class journal in the country. It is not local in its interests. The information which it seeks to convey is for daily use. Its editors are engaged in the practice of their profession and are alive to the promotion of its interests. It very justly, therefore, claims the hearty support of the Engineers, Architects and Surveyors throughout the entire country. It has already won its way to favor in every State and Territory in the Union, and it is undoubtedly supplying a want long felt.

The editors solicit the co-operation of the profession. There are engineering works in city, town and country, in progress, of which reports would be very acceptable; there are surveys being made, an account of which will be of interest; let them be duly chronicled in the columns of the ENGINEER, ARCHITECT, AND SURVEYOR. Send also the names of all whom you think might become subscribers, and by personal solicitation assist in building up a strong professional journal.

There are no subjects pertaining to the professions in which the ENGINNEER, ARCHITECT, AND SURVEYOR is not interested and it is proposed to adopt the plan of obtaining information requiring investigation, by such series of questions as those following, the results of which shall be laid before our readers from time to time. We take the liberty, therefore, to address each of our subcribers, upon the subject of *County Surveyors*, and will be obliged if each will give as free replies as possible and as unbiassed as a candid enquirer after truth *can* give.

We wish to have the answers returned to us as soon as possible so as to incorporate them in an article for our next issue.

1. Does the office of County Surveyor exist in your State?
2. If it does, is it an elective office and what is the length of the term?
3. What are the fees, and are they regulated by the State legislature?
4. What are the expenses attending the office, and what is a fair average income of surveyors throughout your State?
5. What is the law respecting surveys or subdivisions? who may make them; and is the signature of the County Surveyor an absolute necessity to make them legal?
6. Can the County Surveyor's work be reviewed, and his lines, if found incorrect, be corrected by another surveyor?
7. Are there any duties required of the County Surveyor by law, that appertain exclusively to his office, as laying out highways, establishing corners, etc.?
8. What are the laws, if any, relating to surveys?
9. What is your opinion of the Office of County Surveyor? Are there any public interests subserved by it that could not be done without it? Does it produce good surveyors? does it ensure careful and accurate surveys? does it help to elevate the profession in the public estimation, and is it an improvement on open competition between surveyors?
10. What instruments are mostly used for fieldwork in your State?
11. Why do not more surveyors use the transit instead of the compass and a light steel chain in place of the heavy iron one? what are the reasons, if any, irrespective of their cost?
12. From your acquaintance with the profession in your State, what is your opinion respecting the intelligence and skill of its members?
13. Cannot an interest in practical Surveying and Engineering be created in your State by means of such a journal as the ENGINEER, ARCHITECT, ANDSURVEYOR, so that in time you would reap an advantage from it?
14. Whether you are a subscriber or not, please send answers to such of our questions as you may be disposed to, and any other information relating to surveying in your State, that only men in actual practice can give.

CHICAGO, ILL., OCT. 15, 1874.

CONTENTS.

Greasy Water in Steam Boilers,	101	Civil Engineer's Club of the N. W.,	112
Sewerage in New Haven,....	102	Drainage,...	112
Harbor and Coast Surveying,.	104	U. S. Land Office Notes,.....	112
Henderson Water Works,....	106	Law and Legislation,.....	113
Sewer Pipes: Cement v. Stoneware,.....	106	Standards of Lengths in various cities,.....	114
Publisher's Announcements,..	108	Relation of the Engineer and Surveyor to Sanitary Science,	114
Fireproof Construction.....	108	Production of Gold and Silver,	115
Our Note Book,.....	109		
Answers to Correspondents...	110		
City Engineering in New Haven	111		

FIRE-PROOF CONSTRUCTION.

(III.)

Though timber has been almost universally condemned as too inflammable to be used in structures intended to be fire-proof, we understand that insurance companies consider the risk somewhat *less* in buildings the floors of which are supported by timber columns, than in those where cast-iron columns are used, for the reason before mentioned, viz: that while cast-iron will warp and split when exposed to a certain heat, most timber will burn merely on the outside when exposed to the same heat, and on the application of water the flames will speedily be quenched, while the cast-iron columns would fly to pieces immediately.

A $12'' \times 12''$ timber post will generally bear the weight of ordinary warehouse or factory flooring, even when half burnt through.

As the most general cases of improper use of timber in buildings may be mentioned: placing it too near flues; laying hearths, stoves, furnaces, hot-air and other heating pipes, on timber flooring; inserting wooden plugs

into flues to which to fix wainscotting and skirting boards. A good plan suggested by a contemporary, is to fill the holes left in the walls with plaster of Paris cement, at the time of fixing the skirting boards, and bed the screws fastening them, into the cement which sets quickly, and thus holds them as fast as any screws driven into wooden plugs.

Other frequent faults in building structures intended to be fire proof, are: leaving spaces in partitions, behind skirtings, and in floorings, through which, in case of a fire, a draught is created; using common flues as furnace flues; building windows overlooking each other (in adjoining buildings); staircases without doors on the various landings; not carrying party-walls sufficiently high above the roof to prevent a possible fire from communicating to adjoining roofs.

Experiments recently made near London, England, prove the usefulness of fire-brick blocks, when properly applied, as a fire resisting material, and are worth notice here. In the first experiment a furnace 15 ft. long by 4 ft. wide was made, and across the top a rolled I beam or joist 17 ft long, 10″ deep, and with 5″ flanges, was laid, protected with fire brick blocks, presently to be described. Across the spaces between the girder thus encased and the walls, common brick arches were sprung in the usual manner, and the top of the whole covered with concrete, in which strips of wood were inserted, to which the flooring would be spiked.

The fire-brick blocks in which the girder was encased were each 9″ long × 2″ wide, and moulded with an L-formed recess on one side which fitted half the bottom flange of the girder, so that when one row of blocks was placed on each side of the beam they fitted close together, and the longitudinal and transverse joints were closed up with fire-clay cement. The floor was loaded with ¼ the breaking weight of the structure to correspond with the conditions of use in an actual building.

When the structure had dried, a fierce fire was kept up in it for 2½ hours, and then suddenly quenched by a quantity of cold water thrown over the whole structure. The greatest deflection of the beam observed during the progress of the fire was 1¼″, but when the load on the flooring was removed, and the girder had cooled down, no deflection was perceptible, and the beam was uninjured, though the surface of the fire-brick blocks was vitrified.

In the second experiment with the same structure, a fierce fire was kept up for 1½ hours, and continued at a more moderate rate for 28 hours longer, and then suddenly quenched as before. The deflection of the loaded beam was 3-32″ before this experiment, and 1 3-16″ during the fire, and ⅜″ when the load was removed but the beam still hot; when the beam cooled down it returned to the original deflection of 3-32″.

While the fire was at its hottest in each experiment, the end of the beam projecting through the wall was cool enough to be touched with the bare hand.

These experiments are interesting and conclusive as to the value af that particular method of construction.

From reading most of what has been written on the subject, and the records of numerous fires, we arrive at the general conclusions, that a building intended to be fire-proof, should be cut up into as many compartments as possible, consistently with the purposes for which the building is intended, each compartment capable of being entirely shut off from those adjoining by fire-proof doors; also, that all staircases should likewise be isolated from the rest of the building, either by being placed on the outside of the same, or, if constructed as usual inside, by solid enclosing walls. Each staircase should also be provided with fire-proof doors on each main landing at least, by which it may at any time be divided up into separate compartments, like the remainder of the building. By adopting these precautions a fire may be confined within small limits, and thus comparatively easily subdued. The great art in fighting a fire is to prevent its spreading, and thus by bringing all available force to bear, speedily to quench it.

All windows, and other external openings, should be fitted with shutters capable of being opened from the outside, and yet *burglar-proof*, and a contrivance which would simply and economically accomplish this should prove a fortune to the lucky inventor.

We have further remarks to make concerning the origin of fires. but space will not permit of it in the present number.

OUR NOTE BOOK.

The attention of our readers is called to the column of Publisher's Announcements, which appears each month, in the middle of the Journal, over the table of contents; many matters of interest will from time to time be found there.

We hereby draw attention to the list of questions which appear on page 108.

The office of Surveyor, in the West, is an elective office, similar in all respects to those of other county officers, such as the Sheriff, County Clerk, County Treasurer, &c.; is tenable for four years in this State (Ills.), and is too often used for political purposes throughout the West. A candidate not infrequently comes to the head of the poll whose only qualification consists in his being the right shade of politics for the majority of electors, and thus men sometimes fill the office of County Surveyor whose professional qualifications are of the slighest; fortunately, however, the system of deputizing, and the exercise of judgment therein, mit-

igates occasionally some of the evils consequent upon the ignorance of the County Surveyor himself.

We also call for correspondence on the subject indicated in "Standards of Length in various Cities," from those of our subscribers who are City Engineers and Surveyors.

We acknowledge, with many thanks, the receipt of the following documents, from the City Engineers or Surveyors of the respective cities, and others: Mayor's Message and accompanying Documents, of the City of St. Louis, Mo., for the years ending March 31, 1872, '73 and '74; Reports of the Board of Public Works of Chicago, Ills., for the years ending March 31, 1871, '72, '73 and '74; Report of the Board of Commissioners of Public Works of Brooklyn, N. Y., for the year ending Dec. 31, 1872; New Haven City Year Book for year ending Dec. 31, 1872; Report of the Engineer's Department of Louisville, Ky., for the year ending Dec. 31, 1873; a Memoir of the great iron Bridge over the Missouri River, at St. Joseph, Mo., has also been received through the courtesy of the President and Engineer of the Detroit Bridge and Iron Works; also a full Report of the arguments of counsel and decision of the Judge of the Supreme Court in the case referred to under "Important Land Decision," p. 98, from the President of the United States Freehold Land and Emigration Company.

These shall all be carefully analyzed, and the result laid before our readers in due time. We are much pleased with the spirit shown in the responses to our request for City Year Books, and take this occasion of renewing the same to other Engineers.

We are also indebted to the City Engineer of St. Louis, for interesting correspondence on stoneware v. cement pipes for sewerage, which we reprint, in part, elsewhere.

In the "Important Land Decision" page 98, it should have been mentioned that *spanish square league* therein mentioned, is the *legua cuadrada* of which the lineal measurement is a geographical league of 20,000 Castillian *pies*, or 3.455 English miles. If the Mexican league was based upon the *vara*, or Mexican yard, the quantities in the above mentioned article would be considerably less, as the *vara* meas ures only 33⅓ inches while the English yard measures 36 inches.

If the Mexican league then, contained 5280 *varas* as the English league contains 5280 *yards*, the area in one square league would only be 7.716 square miles, and in 22 such leagues 169.752 square miles, or 108,641.28 acres.

The price per acre of the public coal lands is $10 where the land is situated *more* than fifteen miles from any completed railroad; and $20 per acre when the land is *within* fifteen miles of such road.

ANSWER TO CORRESPONDENTS.

MESSRS. EDITORS: SPRINGFIELD, ILL., Sept. 28, 1874.

In answer to the inquiry of "M. C., City Engineer of Atlanta, Ga.," dated Aug. 28, 1874, you are, in my opinion, in error. I think that all race courses in the U. S, are constructed so that *the mile line is three feet from the interior line of the track*; see *Wilkes' Spirit of the Times.* I have invariably laid out tracks thus.

Very respectfully,
J. M. B., Surveyor.

MR. EDITOR: HARTFORD, CONN., Sept. 26, 1874.

In regard to measuring a race track the proper method is to measure it three feet from the pole, being the inside line of the track, which is the point that the inside horse has to travel, although the track may be wide enough for ten teams abreast.

H. G. L., City Engineer.

MR. EDITOR: BOSTON HIGHLANDS, MASS., Sept. 27, 1874.

You are somewhat in error in your answer to your Atlanta correspondent in September number. According to the By-laws of the National Association the length of a race track is to be "measured three feet from the pole, that is to say, from the inside fence or ditch." That this must be so is evident from the fact that the inside horse would travel much less than a mile, if the distance on the *centre* of the track were just a mile, which would be manifestly unfair. Formerly the distance from the pole was 3½ feet, and we protest against the action of the National Association in fixing it at three feet, as no driver would dare run so close. The best drivers rarely come nearer than four feet.

G. & W., Civil Engineers.

MESSRS. EDITORS: NEW ALBANY, IND., Sept. 30, 1874.

I think the following rule for the correction of random lines is simpler than that given in No. 6: Multiply the falling in links by .3438 and divide by the distance in links, the result is the correction in minutes.

G. M. S., City Engineer.

MESSRS. EDITORS: MONROE, LA., Sept, 11, 1874.

Will you please inform me, through the columns of your journal, which you would prefer, a magnetic needle of five or six inches length, for running a course with accuracy? It appears to me that the shorter needle would be more sensitive, and occasion less error from diurnal variation than the longer one.

In response to your inquiries as to the "length of occupancy giving title in various States," I would state that, according to the law in Louisiana, the length of time required is either ten years or thirty years; ten years when held in good faith, and by a just title, and thirty years when held without any title on the part of the possessor, whether in good faith or not. Refer to civil code as follows:

Art. 3474. Immovables are prescribed for by ten years when the possession has been in good faith and held by a just title during that time.

Art. 3475. Immovables are prescribed for by thirty years without any title on the part of the possessor, or whether he be in good faith or not.

I improve the occasion by stating that your journal has equalled my highest expectations.

B. McL., Parish Surveyor.

A shorter needle is generally more sensitive than a longer one, (see Compass Needles, p. 63 of No. 4); but the length of a needle has not the slightest influence on the amount of error from diurnal variation, for the angle of variation will of course be the same in every instrument, no matter what length the needle may be. Large needles are to be preferred to small ones for the only reason that the graduated circle is necessarily also large, and can be divided into a greater number of visible equal parts than can a small one.

EDITOR.

MR. EDITOR: PULASKI, O., Sept. 27, 1874.

I am much pleased with your instructive paper, affording as it does, a medium through which we surveyors may attain a greater uniformity of practice. Heretofore such diversity of opinion and practice have prevailed as to produce much litigation, and to bring the profession into considerable disrepute. I am glad to know that these differences are speedily being removed by the "Answers to Correspondents," and the columns of "Law and Legislation." One of the questions upon which diversity of opinion seems to exist, is the subdivision of the simple ¼ section. My practice has been in accordance with your answers, and with the practice of the correspondents "T. H." and "W. H. C."

The case is argued sufficiently well by them to require no more in addition. The township is independent in its subdivision from any other township, because its corners are established, and its bounds are fixed. For the same reason the subdivision of the section is independently performed; refer to paragraph 129 of Law and Legislation. Refer to paragraph 46 of the same, and to section 41, from Act 11, Febuary, 1805, and you find that while the lines quartering the section have not actually been run, and centre corners established, yet in the eye of the law they are just as much estakblished as if they had been run. Hence the bounds of the ¼ are made independent, shall we therefore make an exception and render it dependent by refering to the other quarters for its subdivisional lines? May we hear from "B. K." again, or any others who support that method. We wish to know the reasons for their method.

Will Jas. Blair please give formula for computing the ordinates and perpendiculars, and illustrate a little by examples.

E. B. O., County Surveyor.

CITY ENGINEERING IN NEW HAVEN.

The City of New Haven is governed by the usual city government of Mayor, 14 Aldermen and 28 Councillors. The standing committees on matters of engineering and surveying are five in number, viz., On Roads and Bridges, Sewers, Streets, Squares, and Water, and are each composed of one alderman and of councilmen.

Taking the various other Committees and Boards in the order in which they occur in the City Year Book for 1874, from which (and that for 1873) all our information is obtained, we find first the Report of the Board of Road Commissioners. This Board consists of the Mayor as President, one Alderman, one Councilman, and two Commissioners at large, and has the general supervision and control of all matters referring to the streets, sewers, wharves, and parks. Following this comes the report of the City Surveyor to the said Board, of the work done during the year by the City Engineer Department. This department consists of the City Surveyor and the First Assistant Engineer as general officers, and is subdivided at present into the Sewerage, Special Engineering, and Surveyor's Departments, and Board of Compensation, Assessments, etc., etc. The Sewerage Department consists of one Assistant Engineer, two Assistant Engineers and Draughtsmen, and one Transit man and Leveler, who attend exclusively to the design and construction of the system of sewerage proposed by Mr. E. S. Chesbrough in his report, which we reprint elsewhere, and now being carried out. The work of the Special Engineering Department during the year 1873 consisted in an accurate survey of a portion of the city; this department consists of one Assistant Engineer, one transitman and leveler, and one rodman. The Surveyor's Department consists of two Assistant Engineers, one transitman and leveler, and one rodman, who attend to the paving and grading of the streets, and surveys for improvements, and any engineering work not done by the two former departments.

Next follows the Report of the City Inspector, which deals chiefly with the maintenance of streets and bridges, and construction of new cross-walks.

The two next Reports of the Standing Committees on Streets and on Sewers are very short, the duties of these committees being confined to the examination of petitions for and against the construction of the streets and sewers, and assessments for the same.

Passing by the Reports of the Fire Department (three in number), and Police Department (two in number), we come to several reports of various committees, among which are those of the Standing Committee on Water, and Committee on Harbor Improvements; from the former we learn that the City of New Haven is supplied with water by a private company, under contracts which expire in 1882, and at an annual expense of $12,200, and that the length of mains laid and in use at the close of 1874 was 72 miles, of which seven miles were laid during that year. The Committee sensibly advocate the laying of the mains in advance of the paving of the streets. To the report of the Committee on Harbor Improvements we shall again refer hereafter.

This is followed by the reports of the Supervisors Department, three in number, comprising that of the Board of Supervisors of Steam Boilers, that of the Inspectors of Steam Boilers, and list of various inspectors and minor city officers. The Board of Supervisors consists of three members, whose term expires July 1, 1874, '75, and '76 respectively, one Inspector of boilers and the clerk. From their reports it appears that during the year 1873 the Inspector visited 219 premises where steam boilers were used, and examined 75 boilers internally and 38 externally; also tested 45 boilers by hydraulic pressure.

Of the boilers tested two were condemned as unsafe. He found 22 steam gauges to be of defective register or out of order, and 7 low-water detectors shut off from the boilers or out of order. In all cases the means for supplying water to the boiler were found sufficient. Inspections made by the Hartford Steam Boiler Inspection & Insurance Comp'y are approved by the Board, and amounted during the year 1873 to 33 in number. These inspections were made for the purpose of insuring persons against risk of explosion, and some very interesting extracts from the report of the President of the H. S. B. I. & I. Co. were inserted in the Report of the Board of Supervisors, which we shall reprint in our next issue.

Most of the remainder of the volume is taken up with various accounts of city, town and State Departments, among which are the Reports of the U. S. Signal Service Station, Meteorology of New Haven for 1873 by Prof. Loomis of Yale College, and the Board of Health. The volume of 479 pages is closed with a statistical account of New Haven, written in the year 1811, by Dr. Dwight, President of Yale College, and by a carefully compiled index of three pages.

The book is carefully printed in large type, on good paper, and illustrated with well executed wood cuts of the City Hall, Police Building, and High School, three lithographic plates accompanying Report of Sewerage Department, and a lithographic map of the City and Harbor of New Haven in 1875.

(TO BE CONTINUED.)

Public lands for the purposes of sale are divided into agricultural and mineral lands. The minimum price of the former is $1.25, and of the latter $5.00 per acre.

CIVIL ENGINEERS CLUB OF THE N. W.

The 2nd meeting of the season of this Club was held on the 12th inst., in the room belonging to the Chicago Chapter of the American Institute of Architects, 145 Clark Street. Pres. Chesbrough presided, and there was a fair attendance of members and their friends.

A paper was read by Mr. H. W. Farley, of Oswego, Illinois, upon "A System of Transportation by Horizontal Conveyer."

This system, as explained by the author, was to place a continuous belt joining the two termini of the route upon which the transportation was to be effected, and fixing upon the belt, either cars placed at suitable distances apart, or a continuous trough.

The author considered his system a good method to be adopted for the cheap transportation of grain, for which purpose he had made the following estimates.

The cars fixed on the continuous belt were to hold 2 bushels of grain for 5 feet in length of belt. This belt was to be supported on friction rollers and kept moving at a uniform speed of 4⅓ miles per hour by stationary engines of 150 H. P. (indicated) placed 10 miles apart. Weight of the moving part of conveyer was estimated at 19 lbs. per foot, of the load of grain, 24 lbs., total weight, 43 lbs. per foot, or 1140 tons per 10 miles in length; weight of empty belt returning, 502 tons; total weight to be moved by each engine, 1,642 tons. Estimated amount of coal to be used, 3 lbs. per indicated horse power per hour, on which basis the amount of fuel required for one year's use of a double track 1000 miles long, would be 165,000 tons, which at $5 per ton, would cost $825,000.

Cost of oil per annum was estimated at $170,400, or $5.66 per section of 10 miles per diem. Cost of labor $1,310,500 per annum; estimated cost per mile, $20,000; sinking funds for repairs, $1,645.90 per mile per annum.

General estimated cost of operating a 1000-mile double track was, per mile; fuel, $825, oil, $170.40, labor, $1,310.50, repairs and depreciations, $1,645.90, interest on cost per mile at 10 pr. cent, $2,000; total estimated cost per mile for 1,000 miles, $5,951.80.

The author further stated that 60,000,000 bushels could be moved 1000 miles in one year at less than ten cents per bushel, or 3½ miles per ton per mile. If the interest account were deducted from the above estimate, the cost of transportation would be rendered 2¼ mills per ton per mile, or less than ¼ the cost of transportation by a railroad.

At the conclusion of the paper a vote of thanks was passed to the author, and the proceedings terminated.

It is estimated that up to the year 1869, 13,000 towns and cities had been laid out upon the public domain since the organization of the land system.

DRAINAGE.

The proper drainage for buildings is a matter of importance. Cellars may be wet, stables not very dry, water may drip from the eaves, cutting holes into the earth and making puddles. The water from such puddles filters directly into the cellar, so that old houses in the country are very frequently dangerous to life on account of the water settling into the cellars. A damp cellar may sometimes be made dry by making a sink in it. Cellars are sometimes made in such wretched places that they need drain-pipes to carry off the water. In arranging any of this kind of work about a stable, it is necessary to be careful that the drainage of the stable does not filter into any water required for domestic use. Water should on no account be allowed to drip from the eaves; it is a great nuisance, undermining foundations and rapidly destroying buildings.

Air confined anywhere, even in a clean room, becomes offensive, probably unhealthy, with a disagreeable smell of closeness, and confined with filth in a drain or sewer, it must be infinitely worse. Drains built tight, with traps, etc., so that there is no ventilation of their interior, generate very poisonous gases, which are ready on the occurrence of any small leak to escape and poison everybody that happens to go near them. The best arrangement for ventilators in houses is to have a separate flue built in the chimney stack expressly to receive the ventilator pipes. Thus the air from the drain is discharged high in the atmosphere in a position to be mixed with smoke; and the noxious properties are destroyed, the smoke, whether of wood or coal, containing about the best chemical disinfectants known.

In all parts of New England hundreds of people are dying every year of typhoid fever. A large tract of the city of Boston is now building on made land, nearly as flat as the prairies about Chicago; and in a few years it will have to be regraded and rebuilt to get rid of this pestilence. From Maine to Pennsylvania there are flat undrained fields,, and wet cellars nearly as bad. All over the country further South, but principally in the Mississippi Valley and the flat country bordering the ocean, the half-drained land is infested with intermittent fever and other malarial pestilence to such an extent as to destroy many thousands of people every year; so that, in spite of constant immigration, extensive tracts of country are about as sparsely settled as they were when Pocahontas saved the life of John Smith.—*D. Joseph Wilson.*

U. S. LAND OFFICE NOTES.

The appropriations made by Congress for the present fiscal year amounts to $855,000; the estimates for the ensuing fiscal year amount to $936,700.

The demand for lands by actual settlers under the homestead law continues very large. During the fiscal year ending June 30, 1873, 31,246 preliminary entries were made, covering an area of 3,752,347.26 acres. The number of final entries was 9,894, being an increase of final entries of 4,115 over the preceding fiscal year.

By act of Congress March 2, 1831, depredating on the public timber is a criminal offense punishable with fine and imprisonment.

During the fiscal year ending June 30, 1873, 6,083,536 acres of land were certified for railroad purposes, an increase over the previous year of 2,528,649 acres.

From a circular recently issued by the American Society of Civil Engineers, we extract the following:

The promoters of several schemes for rapid transit for passengers, and for improved methods of delivering, storing and distributing goods and freight in and about the city of New York, having expressed a desire to meet the committee recently appointed by this Society to investigate the above subject, in order to explain their plans in person, notice is hereby given that the committee will be in attendance at the rooms of the Society, from 1 to 4 P. M., on the following dates: Oct. 15th, 22d, 29th, Nov. 5th and 12th.

Correspondence on this subject is also requested. Address, up to Nov. 14th, to the Secretary, 63 William Street, New York City.

ERRATA.—Page 78, column 2, line 23 from the bottom, the formula should read $\sqrt{\frac{(25)^2 \times 6.6}{6}}$

Page 85, column 1, line 7 from the top, should read "three inches in *sixty-six* feet too long."

Page 99, column 1, line 19 from the bottom, 11,937 and 262,614 should read 11.937 and 262.614.

LAW AND LEGISLATION.

An abstract of decisions of the Supreme Court of the United States and of the courts of the various States in the Union upon questions relating to boundaries, surveys, etc.

138. Where the original boundaries of private possessions have been destroyed or are unknown, or not well ascertained, a survey made by the owner, in reasonable conformity with the calls of his title deeds or papers, is held to be an ascertainment of the very land owned by him, and to conclude him on principles of public policy, and for the security and repose of others. Yarborough v. Abernathy, 1 Meigs [Tenn.]. 413.

139. If the parties know where the true line is, and by an agreement make another, this would be a parol transfer of the land, and would be void by the statute of frauds. *Ibid.*

140. A survey must be closed in some way or other. If this can be done only by following the course the proper distance, then it would seem that distance should prevail; but when distance falls short of closing, and the course will do it, the reason for observing distance fails. Doe v. King, 3 How. (Miss.) 125.

141. General or directory calls must yield to special or locative calls. Wright v. Mabry, 9 Yerg. (Tenn). 55.

142. A patent embracing land not included in a survey is void as to the excess. Kelly v. Graham, 9 Watts (Pa.) 116.

143. Where a father, before making his will, marks out on the ground the portion he intends for each child, such marking controls rather than the description of the quantity of the land contained in the will. Such marking also controls in suits of ejectment brought by claimant under the children. Hunt v. Devling, 8 Watts (Pa.) 403.

144. A survey returned more than 21 years is presumed to be correct. Norris v. Hamilton, 7 Watts (Pa.) 91.

145. Part of the description of the boundary of a tract of land contained in a grant was from a certain point "south with A. B.'s line three hundred and ten poles to C. D.'s old corner," and A. B.'s line did not reach C. D.'s corner, nor run in the direction toward it; but at the expiration of the three hundred and ten poles on A. B.'s line, you had to run nearly at right angles to arrive at C. D.'s corner. Held that the line must be run on A. B.'s line three hundred and ten poles, and then a straight line to C. D.'s corner, as by so doing the whole description of the deed would be best conformed to, although two lines would be run, instead of one called for. Shultz v. Young, 3 Iredell [N. C,] 385.

146. It is no objection to the location of a grant that the quantity is ascertained to be more than four times the amount stated in the grant, or that the lines are prolonged greatly beyond the distances, or that course is sometimes disregarded. Fulwood v. Graham, 1 Richardson [S. C.] 491.

147. A grant of land bounded on a highway carries the fee in the highway to the centre of it, if the grantor at the time owned to the centre, and there are no words showing a contrary intent. Johnson v. Anderson, 6 Shep. [Maine], 76.

148. The title to the soil and freehold over which a highway is laid, is presumed to be in the owners of the adjoining land, until the contrary is shown. Copp v. Neal, 7 (N. H.,) 275.

149. Where it is the intention of parties to convey land adjoining a highway so as to exclude the highway, such intention must appear in clear and explicit terms, otherwise the fee passes to the centre of the highway. Champlin v. Pendleton, 13 Conn., 23.

150. Where a navigable stream intervenes in running the lines of a section the surveyor stops at that point, and does not continue across the river. The fraction thus made is complete, and its contents can be ascertained. Therefore, where there is a discrepancy between the corners of a section as established by the United States, and the lines as run and marked, the latter does not yield to the former. Lewen v. Smith, 7 Port. [Ala.], 428.

151. Grants by government are to be construed according to the common law, unless it has done some act to qualify or exclude that construction. Therefore, a grant by the United States of land lying upon the Mississippi river, without reservation, passes to the grantee a title to the middle thread of the current, that river not being navigable at common law. Middleton v. Pritchard, 3 Scam. [Ills.], 510.

152. A deed of conveyance of land, bounded by a line running "to the river at low water mark." Hence, up "the river at low water mark," &c., passes no title to the land within the bed of the river. Hopkins v. Kent, 9 Ham [Ohio], 13.

153. The owner of land bordering on an unnavigable river will own to the thread of the river. Ingraham v. Wilkinson, 4 Pick (Mass.,) 268. Greenleaf v. Kilton, 11 N. Hamp., 531. Starr v. Child, 20 Wend. (N. Y.,) 149. Williams v. Buchanan, 1 Iredell [N. C.], 535.

154. Land formed by alluvion in a river is, in general, to be divided among the several riparian proprietors entitled to it, according to the following rule: Measure the whole extent of their ancient line on the river, and ascertain how many feet each proprietor owned on this line; divide the newly formed river line into an equal number of parts, and appropriate to each proprietor as many of these parts as he owned feet on the old line; and then draw lines from the point at which the proprietors respectively bounded on the old, to the points thus determined, or the points of division on the newly formed shore. Deerfield v. Arms, 17 Pick (Mass.), 41.

155. This rule is to be modified under particular circumstances; for instance, if the ancient margin has deep indentations or sharp projections, the general available line on the river ought to be taken, and not the actual length of the margin as thus elongated by the indentations or projection. *Ibid.*

156. A call "up the creek" means, ordinarily, a line to run with the creek, and not to indicate the general course of the line merely. Buckley v. Blackwell, 10 Ohio, 508.

157. Whether a monument or boundary referred to in a conveyance is identical with that found upon the ground, and which is supposed to answer to it, when disputed, is a question of fact for the jury. Doe v. Cullum, 4 Ala., 576.

158. Parol evidence was admitted to identify the land ascribed in an original grant, which was produced on the trial of an action to try titles and to establish the artificial and other marks referred to in the origina plat of the land. Foreman v. Sandefur, 1 Brevard (S. C.), 474.

159. A dotted line upon a map is not *per se* conclusive evidence that the line was run, but parol evidence may be introduced to explain the character of such line, and prove that it was ever actually run and marked. Newman v. Foster, 3 How (Miss.), 383.

160. To prove a boundary a map which has been treated for many years by the proprietors and purchasers as the original map, may be received in evidence. Harmer's heirs v. Morris, 1 McLean (Pa.), 44.

161. But remarks made upon the map by a proprietor are not evidence *Ibid.*

162. The declaration of a tenant, after he has aliened his right and interest in the land, is inadmissible evidence to prove where a line ran or a tree stood. Felder v. Bonnett, 2 McMullan (S. C.), 44.

163. A private survey, made *exparte*, without order of court, is inadmissible evidence in an action of ejectment to establish boundary. Surgett v. Little, 5 Smedes & Marsh (Miss.), 319.

164. Reputation is sufficient to prove an ancient boundary, and *a fortiori*, an ancient judgment, establishing a boundary long acquiesced in, is admissible. Smith v. Schacleford, 9 Dana, (Ky.), 452. Nelson v. Hall, 1 McLean 518.

165. But such evidence must be something definite to which it can adhere, or be supported by proof of correspondent acquiescence or engagement. A mere report or neighborhood reputation, unfortified by evidence of engagement or acquiescence, that a man's title paper covers certain land, is too slight and unsatisfactory to be received as evidence in questions of boundary. Mendenhalls v. Cassells, 3 Dev. & Batt., (N. C.), 49.

STANDARDS OF LENGTHS IN VARIOUS CITIES.

To elicit information on this important subject, we addressed the City Engineers of some 30 of the principal cities of the United States.

Referring to "Our Note Book," p. 76, "Surveying in Chicago," pp. 69, 85, and "The Miner's Inch," p. 97, it will be seen that sufficient cause is shown for encouraging an agitation on this important subject, and the information subjoined, extracted from the letters of the 12 City Engineers who responded to our requests, prove still further the necessity for the dissemination of a general knowledge concerning matters of engineering science, as practised in all the various cities throughout the country.

The great advisability of having an *exactly* uniform system of measurements throughout the country, if only to prevent expensive litigation on disputed measurements, is too obvious to require further mention.

The *Surveyor of the District of Columbia* writes that:

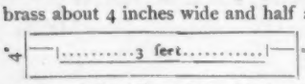
"All comparisons and measures in this locality are adjusted by the U. S. Coast Survey. * * The authorities of the City of Chicago should apply to the Coast Survey Office for a standard chain which should be for the benefit and use of the profession. I know the difficulty that has to be overcome for the want of proper standards. * * The application should be made through some Senator or Member of the House of Representatives from your State."

The *City Surveyor of Baltimore, Md.*, writes:

"The laws regulating the surveying business are rather a dead letter here, excepting so far as they appertain to the City Surveyor's office, and there is no law on the subject of a standard of measure. Our city is behind all others, I presume, on this subject. The customary standard with us has always been a yard measure in the City Comptroller's office, compared occasionally with a standard in Washington—I believe, in the Patent Office; it is the same, at all events, with which storekeepers, and others, have to compare."

The *City Surveyor of Boston, Mass.*, writes:

"The standard used by Surveyors and Engineers, in Boston, is based on a U. S. standard yard, deposited at the State House, and furnished, I understand, by the U. S. Government to the State; each town aud city in this State is furnished with a duplicate of this standard. It is a metal bar of brass about 4 inches wide and half an inch thick, made in two parts, thus:



We had a pine 10-feet rod made for the City Surveyor's office, and very carefully adjusted by this standard yard, and from this 10-feet rod, we have made another standard, 50 and 100 feet in length, by marks in the granite sidewalk in rear of the City Hall. All the surveyors, or nearly all the surveyors in the city test their steel tapes by this 100-feet standard."

The *City Surveyor of New Haven, Conn.*, writes:

"For our own use in the city, I fixed a standard at the City Hall, 50 feet in length, for testing our tapes, etc. To do this, I used a leveling-rod. All our surveys here are connected with the U. S. Coast Survey, and as we have a number of points located by them in and near the city, we are never put to the necessity of measuring a base requiring extreme accuracy. We use Chesterman's steel tapes altogether, which we find very good measuring instruments."

The *City Engineer and Surveyor of Albany, N. Y.*, writes:

"The State of New York by an act of the Legislature, made the U. S. standard yard, or 3 feet, the standard of the State, and requires all surveyors' chains and tapes to conform thereto, and no surveyor can be a witness in any suit, unless his tape or chain has been tested by the State Sealer of Weights and Measures. The U. S. Government furnished this State with set of standard weights and measures. After testing one of my steel tapes, I put permanent marks upon the office floor, to which I have daily reference. * * In surveying rough farm lands, some allowance in addition ought to be made according to circumstances."

The *City Engineer of Pittsburg, Pa.*, writes:

"In 1830, a commission was appointed to adopt a standard for our city, other than the U. S. standard. They did so, and a "Standard Rod" was made and is retained in this office, and by which all our city work is regulated. It is about 1.38 inches longer in 100 feet than the U. S. standard."

The *City Engineer of Harrisburg, Pa.*, writes:

"In this city, the matter you speak of is very carelessly attended to. We have no standard of comparison for the correction of our chains, tapes, etc., unless you except a 50 feet pole which we always use in our office and which we always use for testing our tapes, etc. I have no other reason for thinking this pole to be our standard, excepting that it always has been used as such by former City Engineers."

The *City Engineer of Louisville, Ky.*, writes:

"There is carefully preserved as part of the records of this office, a steel rod, furnished by the State Government at Frankfort, which is exactly 3 ft. long at 60° Far. By means of this rod a distance of 100 feet has been carefully measured on the tile floor of one of the main corridors of the New City Hall. Most of the engineers and surveyors of this City have used our standard, and we have tested chains &c., sent to us from other parts of the State. Most of the improved leveling rods, Chesterman's steel tapes, and some 2-feet carpenters' rules are correct; the Chesterman metallic tapes are all wrong by our standard."

The *City Engineer of Nashville, Tenn.*, writes:

"The standard of measurement by which I test my own steel lines, chains, etc., and by which most of the surveyors of the City and County, also occasionally test, is a distance of 50 feet, measured very carefully on my office floor, using the ordinary triangular boxwood scale as the unit of one foot. This was also compared or tested by two or three Boston rods, and as the result was found to agree, I have referred everything to this standard for a number of years. The subject is important, and I hope your efforts may result in a practical solution of the trouble."

The *City Surveyor of New Orleans, La.*, writes:

"We use U. S. standard yard of brass; also steel standards, (U. S. yards)."

The *City Surveyor of St. Louis, Mo.*, writes:

"This City uses the standard adopted by Government for the standard yard, and for weights and measures, also."

The *City Civil Engineer of Cincinnati, O.*, writes:

"There is kept in the office of the City Civil Engineer, a standard rod 10 feet in length, for testing rods, chains, tapes, &c, This is according to the requirements of an ordinance. Many of our surveyors, however, I believe, have U. S. standards of their own."

[*To be continued.*]

THE RELATION OF THE ENGINEER AND SURVEYOR TO SANITARY SCIENCE.

BY JAS. I. TUCKER, M. D., CHICAGO.

Medical science is as broad as the universe. Not alone is its function to apply drugs to individual affections and diseases; it seeks the solution of weightier problems. It pushes its researches to the ultimate sources of disease, and endeavors to dethrone and destroy that malignant goddess in her remote, and hitherto impregnable fortress. To this end has been created and put to practical working, the intricate and powerful enginery of sanitary reform. In vain church, legislature, and law, if medical science does not take

the lead in defining the limits, and discovering the means of protecting society against its great Decimator. *Mens sana in corpore sano*, or no sound theology, nor effective law. Hereafter the laurel shall decorate the brows—not of poets and orators—but those of the great conservators of the public sanitary weal—the man who labors to preserve the health and prolong the lives, and secure thereby the happiness of the multitude. A grateful people shall bestow its favors less willingly upon Tasso and Schiller, than upon Letheby and Parent-Duchatelet. But not yet, while "three hundred thousand people have taste enough to be in dreamy estacies at the singing of a Madame Pasta, or the dancing of Taglioni, and have not taste enough to appreciate or feel the want of a supply of water in their kitchens, sculleries, drains, sewers, and water-closets." In vain the fond mother folds her darling child to her bosom, if there are still floating in the atmosphere about her the poisonous effluvia which convey the germs of the infant-destroyer. She can feel no security until some of the mighty problems which present themselves to the medical world for solution have been solved. Let us glance at some of these problems.

In our great national metropolis about 13,000 persons succumbed to five attacks of epidemic cholera; 15,000 children died of cholera infantum in twenty-five years; from 400 to 600 die annually of small-pox, and in twenty-five years no less than 50,000 individuals have been victimized by its ravaging marks. Consider these few facts alone, and the query arises, what can be done to arrest the destruction of human life? The sanitarian answers: stifle the cause of disease; pollute the very penetralia of disease. Where does she reside? Search! search! search! Direct the microscope to the suspicious germ, as it reveals itself in Tyndall's illuminated cylinder; discover what is incompatible with *its* life, and let it perish! Probe still deeper! Reveal the conditions which generate the germ, and remove them. All this is being done with a fervent zeal hitherto unknown, and the golden age of health and consequent happiness and longevity is not far distant. Legislatures are enacting laws in conformity with modern ideas; sanitary surveys are instituted and being conducted more and more thoroughly; sewerage is conforming itself to engineering, vitalized by sanitary motives; an interminable war is waging against dram-shops and tippling houses; slaughter-houses, markets, lodging-houses, back-yards, and cellars are being cleaned and disinfected, in the interest of municipal hygiene; water is being supplied in abundance from great lakes and rivers; ventilation is observed in the construction of private dwellings, public buildings, business and school-houses; provision is being made for everything with a view to health, even to the interment of the dead. Thus often are the purlieus of wretchedness transformed into vicinages of health and purity, and these problems which have been under the consideration of the sanitary reformer from the earliest period are being solved, and their practical application realized upon a scale to embrace the whole world.

It is needless to occupy space in pointing out the obvious relations of the Engineer and Surveyor to much of this great work. If he is influenced by these considerations in the pursuance of his daily task, it will be to him like an inspiration to the conscientious performance of his public duty.

PRODUCTION OF GOLD AND SILVER.—A late report on the mineral productions of the Pacific Slope, shows that the total yield of the last twenty five years has been $1,583,644,034, and to this immense sum California alone contributed three-fourths, or $1,094,919,038, nearly all of which is in gold. Nevada is credited with having yielded over $221,000,000 in silver and gold, while Utah, though reputed to abound in mineral wealth, has thus far produced only some $25,000,000, for her mines have but recently attracted the attention of capitalists, who now work them in a proper manner. Colorado seems to beat Utah, having produced some $30,000.000, while the united yield of Washington Territory and Oregon was but little over $25,000,000. Since the excitement caused by the discovery of gold has died out, and mining is systematically carried on, the production has steadily increased. In 1873, the actual yield of the Pacific Slope was $80,287,436; whereas for the year 1872 it was only $70,236,914, which shows a gain of about 14 per cent. The increase is mostly in silver, and meets, therefore, the unusually great demand which has lately been made for this metal. England secures the largest part of the production.

A CURIOUS bronze is produced in Japan, which made in thin plates, resembles slate, and is covered with designs in silver. M. Morin has lately analysed and examined the properties of the alloy, and finds that it contains, in addition to copper, from four to five per cent of tin, and on an average ten per cent. of lead. The combination is easily moulded into thin plates. These are varnished, and through the covering the designs are scratched with a burin. The plate is then plunged into a silver bath, when the silver is deposited on the unprotected portions. Lastly, it is placed in a muffle furnace, when the copper blackens and the silver remains bright.—*American Engineer.*

ADVERTISEMENT.

Throughout the United States and the Dominion of Canada, there are certain places which, by their location and natural advantages, are peculiarly adapted to the development of some great manufacturing enterprise. There are mineral regions which only need to be placed in a strictly truthful position before the public to be appreciated and attract the attention of capitalists. There are great tracts of agricultural and grazing lands in the South and West which are practically unknown, but which, if properly brought to the notice of the right parties, would soon create a demand therefor, and ultimate settlement.

The frequent misrepresentation that has been indulged in with regard to the agricultural and mineral lands of this country, has occasioned distrust in the public mind, and spread to foreign lands, so that it is becoming every year more difficult to induce respectable parties to turn their attention to these important interests. We invite the attention of owners of first-class property, that may be rendered available for manufacturing, mining and agricultural purposes, to "THE ENGINEER, ARCHITECT, AND SURVEYOR" as being a first-class medium for thoroughly advertising the same. We are prepared to visit and faithfully survey, map and illustrate any such property in the United States, and we will at any time give references as to our ability to investigate and correctly report the same.

The work will be executed as economically and speedily as possible, and we will always guarantee, that when it is practicable, the information will be laid before the special class of readers for whom it is intended.

We invite correspondence as to terms, etc., on the subject.

SCIENTIFIC BOOKS

For sale at the office of

The Engineer, Architect, and Surveyor.

168 Washington Street,

CHICAGO, ILL.

Ures Dictionary of Arts, Manufactures, and Mines, American edition. 3 vols.	$15 00
Weisbach's Mechanics of Engineering and of the Construction of Machines. vol. 1	10 00
Practical Draughtsman	10 00
Worthen's Cyclopedia of Drawing	10 00
Miller's Organic Chemistry	10 00
Miller's Inorganic Chemistry	6 00
Rankine's Applied Mechanics	5 00
Rankine's Civil Engineering	6 50
Rankine's Machinery and Millwork	5 00
Rankine's Steam Engine	5 00
Bourne's Hand Book of Steam Engine	1 75
Bourne's Catechism of Steam Engine	1 75
King's Steam Engine, Propeller, etc.	2 00
Schintz's Blast Furnace	4 25
Overman on Steel	1 50
Overman's Moulder and Founder	1 50
Haswell's Engineer's and Mechanic's Pocket Book,	3 00
Norris' Hand Book for Locomotive Engineers and Machinists	2 00
Byrne's Hand Book for the Artisan, Mechanic and Engineer	5 00
Wood on Construction of Bridges & Roofs	3 00
Wood on Resistance of Material	2 50
Stoney on Strains in Girders and similar Structures	15 00
Molesworth's Pocket Book for Civil and Mechanical Engineers	2 00
Trautwine's Engineer's Pocket Book	5 00
Narrow Gauge Economy, Fairlie	1 25
Railroad Construction, Vose	20 00
Skilled Labor Applied to Production, Yeats	2 50
Strength of Bridges and Roofs, Shreve	5 00
Elementary Civil Engineering, Mahan	4 00
U. S. System Rectangular Surveying, Hawes	3 00
Theory of Bridge Construction, Haupt	3 50
Mining Machinery and Appliances, Blake	2 00
Steam Engine in Mines, Mills, etc., Bourne	15 00
Hand Book of the Telegraph, Bond	40
Eight Lectures by Tyndall	2 00
Light and Electricity, Tyndall	1 25
Seven Lectures by Tyndall	75
Diamagnetism, Researches by Tyndall	7 00
Manual of Chemistry, Odling	4 50
Almanac and Astronomical Ephemeris, 1868–75	1 65
Beton Coignet, and other Artificial Stone, Gillmore	2 50
Submarine Blasting, Foster	3 50
Fires, Fire Engines, and Fire Brigades, Young	12 00
Van Nostrand's Eclectic Engineering Magazine, per year,	5 00
Manual of Hydrology, Beardmore	12 00
Coal and Coal Mining, Smyth	1 40
Practical Hydraulics, Box	2 50
Storage Reservoirs, Jacob	50
Waterworks for Cities and Towns, Hughes	2 50
Treatise on Metallurgy, Kerl, 3 vols. each,	10 00
Mineralogy Illustrated, Kurr	6 00
Manual of Geology, Dana	5 00
Manual of Mineralogy, Dana	2 25
Iron Smelting, Bell	6 00
Mine Engineering, Greenwell	21 00
The Smoke Nuisance and Remedy, Richardson	50

C. W. TERRY,

Map Mounting and Coloring,

Rooms 24, 25 & 26 Rice's Building,

79 DEARBORN ST., CHICAGO.

Mounting of every description. Coloring, Fashion Plates, Portraits, Illustrations for Books, and Lithographs of every description.

ESTABLISHED 1820.

William J. Young & Sons,

MATHEMATICAL

and **ENGINEERING**

INSTRUMENT MAKERS

No. 43 North Seventh Street,

PHILADELPHIA.

Improved Transits and Levels,

COMPASSES,

Tapes, Chains, Draughting Instruments,

ENGINEERING STATIONERY,

ANEROID BAROMETERS.

PHOTOGRAPHS ON APPLICATION.

Engineers' and Surveyors'

Instrument Maker.

INSTRUMENTS MADE TO ORDER

AT THE LOWEST PRICES AND WARRANTED,

BY

JAMES PRENTICE,

164 Broadway, N. Y.

Repairs promptly attended to.

NICKEL & STRASSBERGER,

47 La Salle St., Chicago, Ills.,

Manufacturers of

Surveying Instruments,

Prices low and each Instrument warranted.

The Army and Navy.

Devoted to the interests of Soldiers, Sailors, and their heirs. Published monthly, at Chicago, Ills., merits the earnest support and patronage of every one, because—

It is the most able and reliable paper of its kind published in America.

It contains a concise and accurate digest of the laws relating to Bounties, Pensions, Prize-money, Back-pay, &c., showing who are entitled, and how to proceed to recover the same.

It will promptly publish all new legislation relating to claims of all kinds, with full explanation as to their scope and meaning of the same.

It is not political and partizan, but simply demands "equal and exact justice to all men."

In addition to this, the ARMY AND NAVY contains, every month, such a quantity and quality of miscellaneous reading matter as will make it a **welcome guest in every home in the land.**

To place it within the reach of all the subscription price has been put down to **only One Dollar a year.** A deduction of 20 per ct. made on Clubs of five or over. Great inducements offered to Canvassers and Agents.

Address all communications to E. S. WEEDEN, Editor and Proprietor, No. 143 E. Monroe Street, Chicago, Ills.

VANDERCOOK & Co.
DESIGNERS & ENGRAVERS ON WOOD
SATISFACTION GUARANTEED
Cor State & Madison Sts
CHICAGO ILL.
SEND FOR A SPECIMEN SHEET OF WORK
ORDERS BY MAIL PROMPTLY FILLED

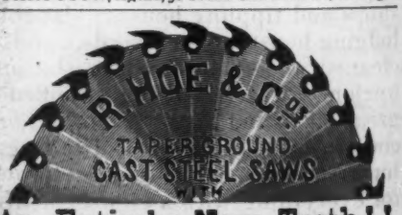
THE BUCKEYE ENGINE CO.

of Salem, Columbiana Co., Ohio.

Manufactures Automatic Governor Cut-off and improved Throttling Engines of all sizes, Thresher or Agricultural Engines, Printers' Engines, (a complete steam motor for all kinds of light work), Portable Saw-mills, Stationary Saw-mills, Hall's self-acting Shingle and Heading Machines and Shingle Mills complete. Our business is to manufacture utility in machinery for a fair renumeration.

Address the Works direct or

J. FARGUSON, Agent, 56 South Canal Street, Chicago.



An Entirely New Tooth!!

Giving a strength and solidity equal to any solid saw.

R. HOE & CO.,

31 Gold Street, New York.

B. KRATZENSTEIN,

Successor to F. Arnold & Co.

Mathematical Instrument Maker.

Surveyors and Engineers' Instruments made to order and repaired.

No. 157 State Street, Chicago, Ills.

Formerly 114 Randolph Street.